The Role of Boundary Crossing for Knowledge Advancement in Product Development

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Abstract: We present an empirical analysis of workplace learning using concepts from Activity Theory. The overall aim is to understand the evolution of a shared artifact in the boundary zone between a commercial organization (company) and its customers, on one hand, and between the company and a group of researchers on the other. The shared artifact is a project planning tool suite developed for customers by the company. We have identified three boundary-crossing activities: product development, user participation, and researchers' intervention and discuss their contributions to knowledge advancement on the basis of two identified contradictions. The interaction between developers and customers identifies a contradiction in adaptive product development, and the interaction between developers and researchers identifies a contradiction in use of a CRM system. We use data excerpts from a video-recorded interview and a design workshop to analyze our findings.

Keywords: Workplace learning, participatory design, empirical analysis, Activity theory

Introduction

The aim of the KP-Lab project[1] is to study emerging knowledge practices for the 21st century and developing tools for understanding and transforming existing practices into knowledge practices. We use the term *knowledge advancement* to describe workplace-learning activities within this context and it serves as an intermediate concept for analysis, connecting workplace tools and human expertise. As a description of practice knowledge advancement is concerned with the development of a joint digital artifact by a group of stakeholders. The perspective on ICT development is *adaptive evolutionary development* (Mørch et al, 2004). To account for the multidimensionality of diverse stakeholders, the traditional view on expertise as a *vertical dimension* is extended with a *horizontal dimension*. This is related to the distinction between *community of practice* and *community of interest* (Fischer, 2001). A community of practice brings likeminded people together (vertical expertise), whereas a community of interest brings communities of practice together (horizontal expertise). In terms of Activity theory this means the integration of multiple, parallel activity systems.

1. Case

The object of study is a relatively small software house (referred to as company) geographically distributed in Norway. At the present, the company employs 25-30 people, but it is rapidly adding both employees and marketing share. The company develops and sells a family of project planning and management tools[2], and provides consultancy

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[1] The project is a part of the European Knowledge Practices Laboratory (KP-Lab) Project (www.kp-lab.org).
[2] The main product is called Safran Project, which runs as plug-in to Microsoft Project and supports the tasks of managing large-scale and complex projects on multiple levels of abstraction.

services in using these tools. To expand to new market segments the company has started to improve its knowledge management practices regarding customer relations. The company's customer relations rested largely on oral and personal connections. These practices are time consuming and inefficient and not aligned with the goal of serving a growing market with diverse customers. The first attempt involved installing a Helpdesk function, but it did not work well (little used). The second attempt (ongoing) is an interactive web-based knowledge tool (web portal for short)[3] integrated with a Customer Relations Management (CRM) tool that the company hopes will be a communication hub between the two national offices, a link between consultants in the field, and to support customer interaction.

The study proposes to analyze knowledge practices in the company by focusing on knowledge advancement in the form of boundary crossing activities: 1) Product development, 2) customer involvement, and 3) researchers' intervention. Customer involvement emerges as a process with its own logic that developers need to understand for further expansion. The focus will be on how the informants reason around these issues.

2. Theory and method

We will use an Activity-theoretical approach when analyzing the data. The object of the activity is what the action within the activity-system is directed towards, which is dynamic and can change in response to the available tools and signs at a given time. The object is oriented towards an outcome. This is illustrated in the top triangle Figure 1. The lower parts of the triangle represent the collective aspects of human activity (Engeström, 1987). Development of an activity system arises from conflicts in the form of contradictions or tensions between the elements in the system.
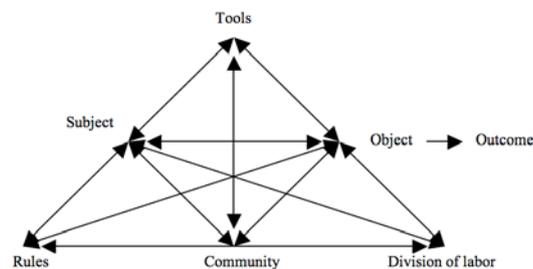
Figure 1: A model of the Activity system, adopted from Engeström (1987).

At a higher level we interpret development in the Activity-system on the basis of expansive circles (Engeström, 2005), which is defined in terms internalization and externalization. Vygotsky (1986) proposed these terms in order to understand how we, on one hand is socialized by our participation in the world, and on the other internalize the same world by abstract symbols and inner speech (thought). Engeström (2005) uses the terms to analyze collective knowledge advancement in an organization. Expansion starts by internalization to allow the novice to pass through processes of socialization, meaning making and concept formation, and it later moves into competent membership in the activity. The process of externalization becomes gradually more dominant as members carry out processes of innovation driven by disruptions and contradictions in the activity system (Engeström, 2005).

We focus on the *horizontal dimensions of expertise development* to account for how experts move between multiple parallel activity contexts (Engeström, 2005). Boundary crossing are used to analyze the horizontal movement between the activity systems.

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[3] The first version of the web portal was developed with the DotNetNuke web application framework.

The research is based on a case study, using multiple methods for gathering data (Yin, 1984). We videotaped interactions and analyzed them as texts. The overall methodology involves a combination of design and analysis and includes participatory design (Namioka and Schuler, 1993), evolutionary prototyping (Mørch et al, 2004), and developmental work research (Engeström, 2005).

3. Empirical Findings

User involvement was singled out as a main feature the company wanted to maintain and improve with new CRM technology. It was also described as a problem with few good known solutions. Hence this problem became central in the boundary crossing activity between the company's developers and the researchers. We start by illustrating how customers are encouraged to participate in the company's product evolution cycle by commenting on the usefulness of the products and suggesting improvements to them. (The extract is abbreviated for space reasons):

Ps3   They send in a request for a new functionality or improved functionality, and when we are developing, then we look (.) we assess it, does it make sense? Will it have a positive impact on other customers? Will it have negative effects for anyone? And if there are others requesting the same feature (...) we look into it on a larger scale? (…).

I2   Can you tell more about improvement-requests?

Ps3   When we go through improvement-requests we check the relevant areas of functionality and consider refactor areas where there are many requests. Then we have to (evaluate) whether they understand it ((the new functionality)), or whether we need to add more to it, and all in all we see this in relation to the rest of the product…

The informant (Ps3) explains the process developers go through in order to take into account user needs, which shows that user participation plays an important role in product development. It requires balancing multiple concerns: user satisfaction, flexibility and time to make improvements. He emphasizes the flexibility of the process, and describes this as a business advantage for the company. This is an example of boundary-crossing activity where the product, or rather the development of the product, serves as a common object between developers in the company and representatives of the customer-companies. The development is driven by a *contradiction* in the customer activity system when an error, shortcoming, or need for local adaptation in the product brings about a discrepancy between the tool and the object of activity of the customers.

The interaction between the two activity-systems typically happens on a individual basis among customer representatives and their appointed contacts in the company who either solves the problem for the customer or acts as an intermediary to direct the request to a more skilled problem solver (software developer) in the case of local adaptation. If the customer requests a larger modification to the product (as in the above excerpt, common for large customers), other members of the developer community will be involved.

Referring to the extract above, the informant goes on to emphasize the value of a systematic and efficient new information sharing system customers can use to submit their improvement requests, and identifies this as an integral part of the new web portal under development (not shown for space reasons). This was seen as a resolution to the contradiction between customers needs (as defined by their business goals) and company maintaining good customer relations (i.e. nourishing their business goals). But as the project went along, our data indicated that informants did not perceive this as a satisfactory resolution of the contradiction. This became apparent during one of the design workshops we (researchers) conducted with the company. The aim of the workshop was to create future scenarios of an improved workplace for integrated work and learning. In one example the participants discussed how to distribute customer improvement requests

among employees (ideally transmitted by the new CRM-system), and which criteria to consider in the design. The discussion revolved around using a minimum of (human) recourses to find the right person to address a problem identified by a customer. They discussed how to rank developers by level of expertise, but they quickly agreed that this was not a good approach. Then Anna suggested that experience with customers should be profiled. Henry responds by referring to the current practice regarding division of labor:

Henry [But anyway] if you are ranked as a developer it's not altogether sure that= assume we have (.) two developers, and one of them is expert on databases and the other graphical interfaces, (.), but as it is now, when I call one of them and ask how:: how can I do this in the database? And he says you first have to talk to Andy.

This extract illustrates how the design of the web portal in the workshop served as the object of collaboration between the activity system of the developers and the activity system of the researchers. The two activity systems differ with respect to rules and values, community of practice and their division of labor (the lower part of Figure 1). But the common object of designing a new tool for knowledge management joins them together. The excerpt illustrates a central contradiction: providing good support to customers and develop the products through customer involvement, while at the same time minimizing the developers' role in customer support.

Although no final resolution of the contradiction was found during the workshop, the episode serves as an example on how the participants were able to identify a common problem and work on it through collaboration, and to create a new design representations for the company (scenarios for how to interact with an improved CRM system).

4. Conclusions

The case study reported, shows activities of a software house in the process of changing some aspects of its current work practice while maintaining other aspects of it. We are in the midst of studying the transitions using Activity theory. Central contradictions in the activity system identified by the company include the gap 1) between existing and planned tools for customer relations and 2) between the current division of labor and the object of serving customers with a high degree of user participation in adaptive product development. To overcome these contradictions, the company, in collaboration with the research team is in the process of designing and implementing an enhanced CRM system (web portal for improved communication and information sharing) to support problem solving and product adaptation. This represents two separate but intertwined boundary-crossing activities. Our contribution offers a methodology (work in progress) to how these processes can be identified, analyzed and resolved using methods and techniques from activity theory, participatory design, and evolutionary prototyping.

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